2030 District Program and Small Commercial Toolkit

2014 Building Technologies Office Peer Review

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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Project Summary (New Project)

Timeline:

Start date: October 1, 2013

Planned end date: March 30, 2016

Key Milestones

1. Develop program resources and tools, 9/30/14
2. Complete demonstrations, 9/30/15
3. Deployment to other 2030 Districts, 3/30/16

Budget:

Total DOE $ to date: $2M (for program and toolkit, no dollars are applied to retrofits – these costs are born by bldg owners)

Total future DOE $: N/A

Target Market/Audience:

Small commercial office and retail buildings within 2030 Districts.

Key Partners:

LBNL	Architecture 2030
Cleveland 2030 District	Green Building Alliance / Pittsburgh 2030 District
Seattle 2030 District	Prospect Silicon Valley / City of San Jose
ASU	Emerging 2030 Districts

Project Goal:

Create 2030 District Program guidance and a technical Toolkit that provides products to promote, develop, and successfully execute 2030 District energy efficiency savings programs specifically for small commercial office and retail, which can be deployed nationwide.

Purpose and Objectives

Problem Statement: The small commercial buildings sector has distinct issues in implementing energy efficiency (EE) –

- Buildings are very resource constrained and lack access to affordable EE expertise (architects, engineers, consultants)
- Existing EE tools and services have high-cost entry points

Target Market and Audience: Commercial buildings under 50,000 square feet, (office and retail) representing over 90% of all U.S. commercial buildings and consumes over 40% of the sector's energy use. Small commercial property currently comprise 66% of the properties in the existing 2030 Districts. Total commercial building stock is 6.5 quads energy use.

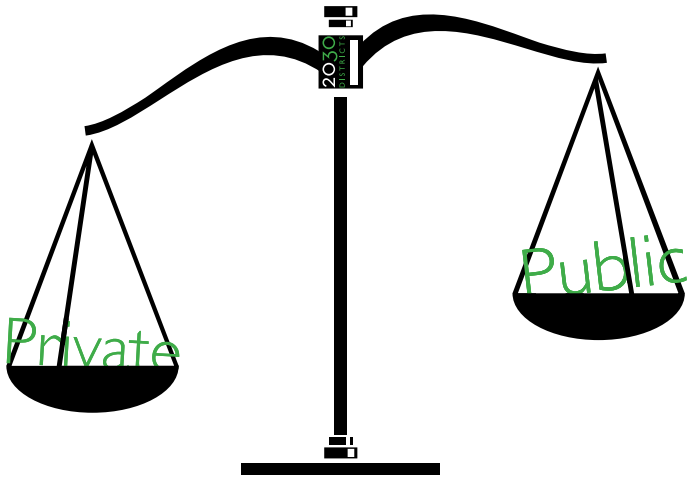
Approach

Approach: District scale approaches provide multiple advantages:

- motivates members
- leverages the needs at scale to deliver EE programmatic offerings such as low cost auditing and Cx, financing opportunities, and early equipment retirement programs.

The best practices these districts employ to establish self-sustaining EE programmatic local resources are captured in this project for use by other districts. A suite of no- or low- cost EE tools and services will be packaged that serve this sector, designed for use by practitioners engaged in this sector, e.g. HVAC or electrical contractors. Existing tools are leveraged, and a small set developed to fill identified needs.

Distinctive Characteristics:
2030 Districts are private sector-led – increases buy-in and ownership of the effort. Independent demonstration areas are tied into a Network with shared goals, timelines and performance metrics. Increases best practice sharing and collaboration.



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Approach (cont'd)

Key Issues: Some key barriers to energy reductions in this sector are:

Technical	Programmatic
1) access to centralized, comprehensive, cost-evaluative information about how to achieve energy targets	5) guidance on bringing disparate stakeholders together
2) access to tools that measure buildings' progress toward targets and provide actionable feedback	6) financial models for district self-sufficiency
3) affordable access to auditing and Cx services	7) member outreach, including to historically underserved communities
4) reduced transaction costs or financial incentives that make reduction efforts attractive	

2030 Districts Network

100M Square Feet Committed

District and Member Reduction Targets	Potential District Savings
20% Individual Building Retrofits by 2015	Up to 240 Million kBtu/year District Wide
10% Aggregated District Savings by 2015	$4 Million in Energy Cost Savings
50% Incremental District Savings by 2030	$17.5 Million/year Economic Activity = $29 Million Asset Value Increases

2030 District + Small Commercial Building Toolkit

Key Project Highlights:

- Year 1 – Program guidance on Districts and Toolkit developed to enable and make easier identification, execution and tracking of efficiency measures and consumption
- Year 2 - 25-40 demonstration sites in 4 partner Districts, 20% reduction target per demonstration + 10% per district by 2015
- Year 3 - Deployment to 5-10 new Districts

Identify > Execute > Track

Year 1 - Program and Small Commercial Toolkit Development

- **Program guidance** is developed by Partner Districts, using best practices from established and emerging districts. Provides multiple models for program approaches to achieve success on:
  - *Management and administration* (launch, scheduling, financial sustainability and funding models, lessons learned)
  - *Member organization* (data disclosure practices, commitment letters)
  - *Outreach and district membership* (community relations, underserved communities)
  - *Public and private sector partnerships* (utilities for Cx/auditing programs, early equipment retirement etc.; financial services allies; service providers, e.g. bulk lighting retrofits; local trade associations, public agencies and community groups)
  - *Benchmark and track energy savings* (member and district scale), metrics, methodologies and platforms

Year 1 - Program and Small Commercial Toolkit Development

- The **Technical Toolkit** identifies, executes and tracks EE retrofits by solving small commercial's unique challenges:
  - Energy efficiency measure online assessment tools
    - Existing tools (eg. PNNL RTU calculator, FEMP calculators for HVAC, EnergyStar Plug load tool)
    - Development of select tools (e.g. lighting retrofit calculator, whole building retrofit calculator (similar to Home Energy Saver)
  - Lack of data visualization and analysis (Open EIS)
  - Auditing and performance feedback (Energy Management Package)
- Central tracking tool to collate results from individual tools and prioritize strategies
- Workshops held with industry stakeholders to understand the features, needs and use cases
- Tool users focused on stakeholders most likely to engage in small commercial buildings – e.g. HVAC contractors, electrical contractors, O&M personnel, and property managers, owners or tenants

2030 Districts - Small Commercial Technical Toolkit

Whole Building Retrofit Evaluation Tool

Lighting Retrofit Calculator

Plug Load Equipment Tools

Case Study Library & Templates

HVAC Tools

Energy Data Visualization and Auditing Tools

Low Cost Auditing Transaction Cost Tools

2030 District Web Resource

Years 2 & 3 – Demonstrations and Deployment

- Year 2 - **Program and Technical Toolkit Demonstrations** - 25 – 40 Small Commercial Sites in demonstration partner cities – Cleveland, Seattle, Pittsburgh and San Jose
  - Application and tracking of energy savings over one year

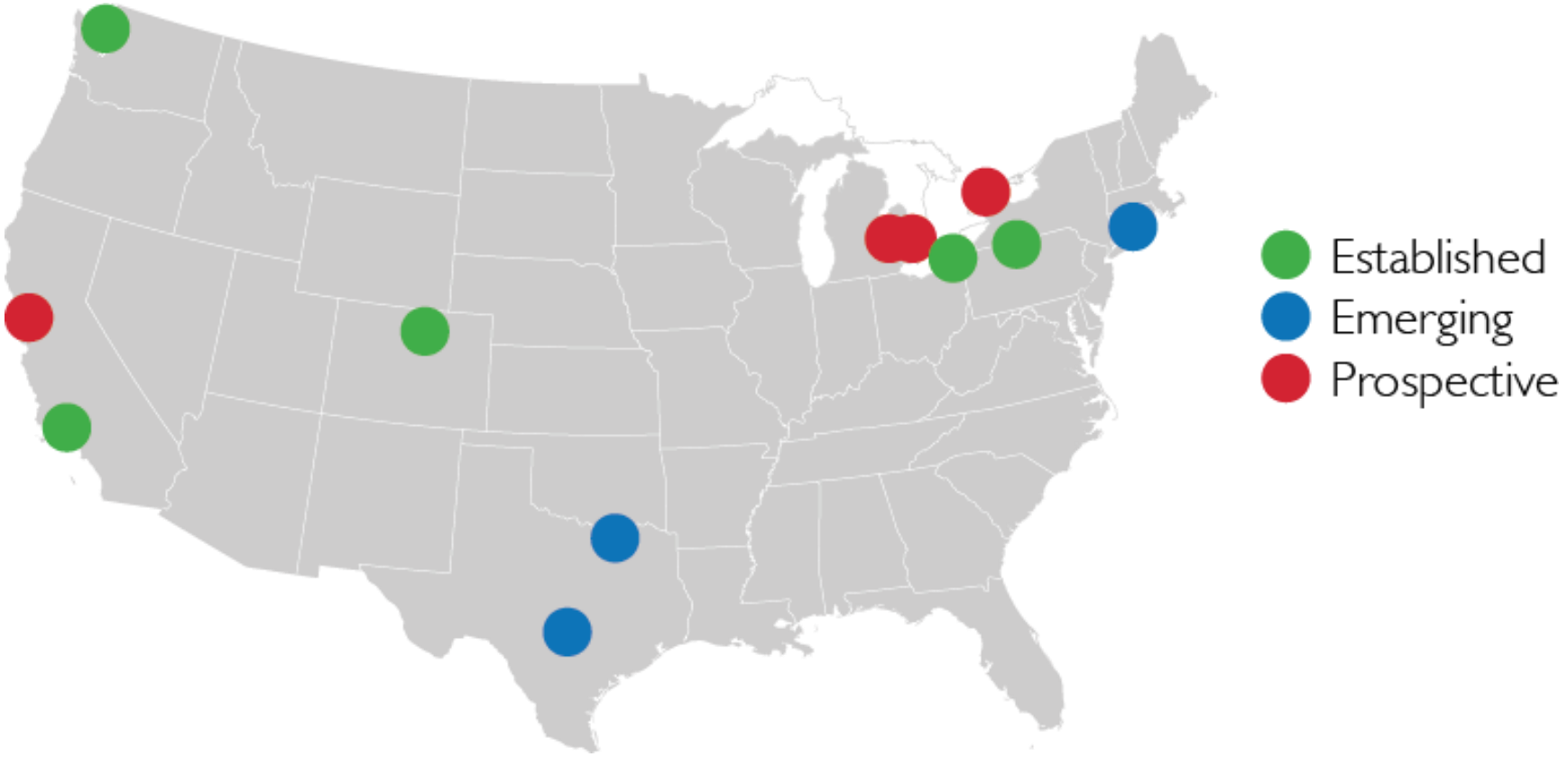
- Year 3 (6 months) – **Verification and Deployment** - Demonstration site savings verification, case study development, outreach
  - Outreach and industry engagement, deploy 2030 District model, establishment of 5 to 10 New 2030 Districts
  - Educate potential partners about demonstrated successes and value to communities/cities
  - Dissemination of 2030 District Program and toolkit through trade associations, outreach
  - Case Studies and other materials disseminated at national conferences and partner events

Purpose and Objectives

Planned Contribution to Energy Efficiency:

1. Year 1 – deliver program guidance to develop self-sufficient 2030 Districts, leveraging peer relationships to influence market uptake of EE. A suite of technical tools delivered, identifying cost effective EE strategies to achieve a minimum of 20% energy savings.
2. Year 2 - 25-40 project demonstration sites targeting a minimum of 20% reduction per site, estimated savings of 11-20 million kBtu/yr. Energy savings reported annually through EnergyStar Portfolio Manager.
3. Year 3 the demonstrations will report energy savings, using EnergyStar Portfolio Manager. Tools and program guidance will be deployed to:
   - 5-10 new 2030 District nationwide (200M sq. ft./commercial space, with 10M sq. ft. of small commercial). 2030 District and members commit to >20% building energy reduction, contributing to a target 10% energy reduction per District.
   - Energy savings up to 2.4 billion kBtu/yr, $40 million in energy cost savings, $175 million/year of economic activity, $290 million of increased asset values, 1640 direct and 3370 indirect jobs.

2030 Toolkit – Emerging and New 2030 Districts



Established
Seattle
Pittsburgh
Cleveland
Los Angeles
Denver

Emerging
Dallas
Stamford
San Antonio

Prospective
San Francisco
Ann Arbor
Detroit
Toronto

Affiliate
Silicon Valley

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Progress and Accomplishments (New Project)

Discoveries: Regardless of technically proficient tools and reasonable ROIs from analysis, any financial commitment to making improvements can deter some audiences. Financial incentive or alternative financing approach is a larger priority for this audience than in large commercial. The framing of EE assessments in the context of the business model of a small commercial owner/advocate can be useful as a first step.

Accomplishments:

- Denver 2030 District launched December 2013, 14 million sf committed. Los Angeles 2030 District has just launched.
- Small commercial tool workshops held.
- Technical tool online drafts completed, including the web portal, case study template, and the tracking tool in development.
- Program guidance working groups drafting guidance on best practices for outreach, membership. MOUs in development for partnerships with larger national organizations (e.g. BOMA, ASHRAE, ULI, Better Buildings Challenge, EPA)

DENVER 2030 DISTRICT

LOS ANGELES 2030 DISTRICT

Progress and Accomplishments (New Project)

Project Contribution to Energy Efficiency : Project has just started, measured results are not yet available. However, the team has completed industry workshops on small commercial tools, developed mockups of new tools and tracking tool, coordinated on web portal and completed some program guides.

- Ensuring or accelerating market outcome(s) –
  - Architecture 2030 is actively fostering inquiries and early formation activities with about 2 dozen U.S. cities, priming the project for early deployment of the program guidance and tools.
  - Industry outreach continuing with conferences and working on industry collaborations with national organizations to partner at the local level (e.g. BOMA).
  - Project team has a history of success – District formation, District energy savings (Seattle 2030 District - over 120 member buildings, 34 Million member Square Feet, and deployed EE to large commercial with savings up to 27%), and tool development (LBNL).

Awards/Recognition: None to report yet.

Project Integration and Collaboration

Project Integration and Communications:

- Small commercial stakeholder workshops on tools, four cities. Included contractors, owners, consultants, utilities and program administrators who engage with the small commercial sector. Further beta testing of tools planned with user groups.
- 2030 Districts hold regularly meeting with their members and stakeholders and has working groups to develop program guidance.
- FOA Project team hold weekly meetings
- Architecture 2030 presented at the 2013 National Preservation Conference, and the 2014 SPEER Summit.

Partners, Subcontractors, and Collaborators:

- Architecture 2030, program guidance and 2030 Districts convener
- Seattle, Cleveland and Pittsburgh 2030 Districts and Prospect Silicon Valley, small commercial outreach, demonstrations, best practices
- ASU, case studies template and library.

Next Steps and Future Plans

1. The project has just commenced a 30 month project period. Tasks that remain include:
    I. Complete program guidance, technical tools and web portal.
    II. Demonstration and deployment.
    a. Risks and mitigation
        I. Feedback from owners is critical to ensure assessment results are framed in their context to enable decisions. We are engaging with these stakeholders.
        II. Additional risk of the tools not achieving intended savings. Tools selected leverage existing products with successful track records, or will be tested through other projects.
    b. No major decision points in near term. Go/No Go at end of Y1.
2. Ensuring future success – Continue to maintain a relationship with 2030 Districts and keep the technical tools updated and functional.
    a. Building on this work – DOE and others may become more involved in 2030 Districts as a market channel for resources and tools deployment.

REFERENCE SLIDES

Project Budget

Project Budget: 2,000k, awarded by DOE FOA-0000829
Variances: No variances have occurred or are expected.
Cost to Date: 135.8k
Additional Funding: N/A.

Budget History					
FY2013 (past)		FY2014 (current)		FY2015 – FY2016 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
N/A	N/A	2,000k	2,000k	N/A	N/A

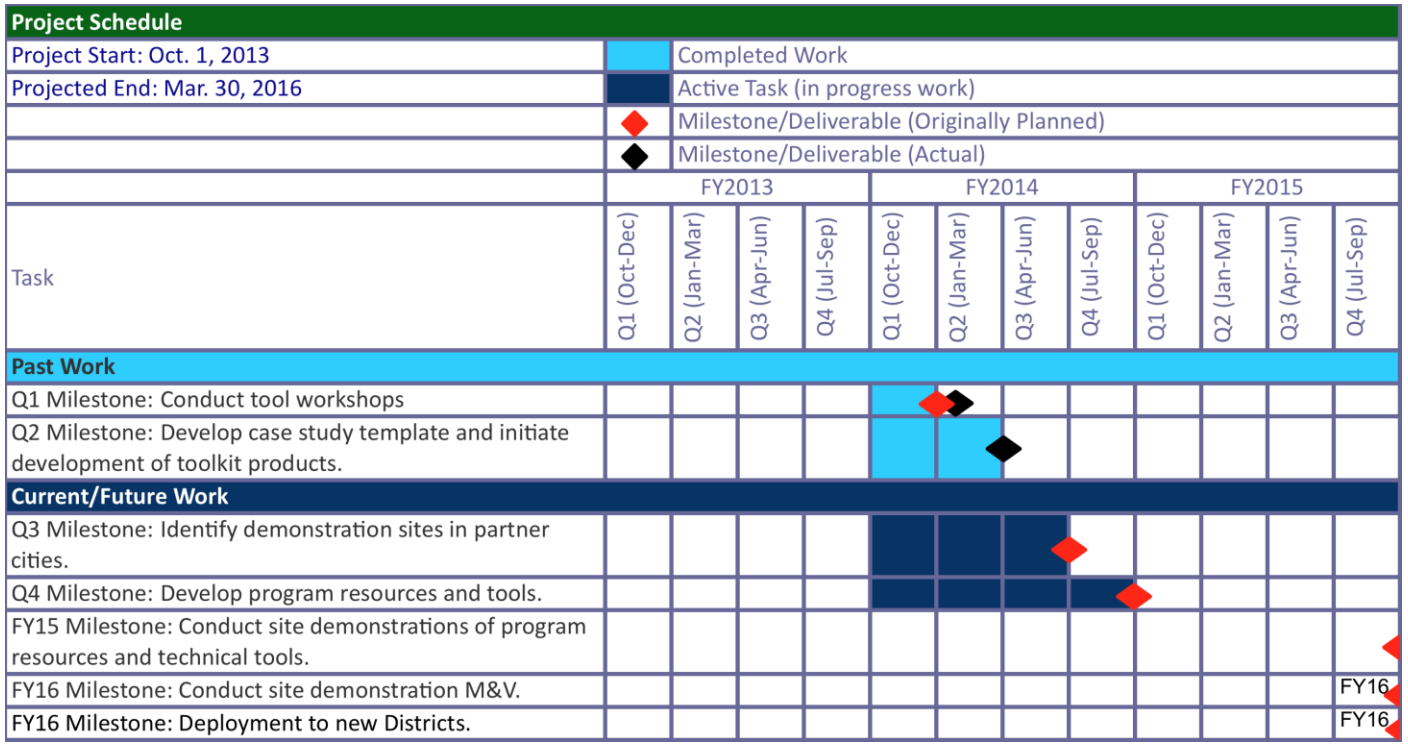
Project Plan and Schedule

Project plan, milestones as noted in the schedule below.

- Q1 milestone was delayed due to scheduling issues with participants

Go/No-go: Stop the demonstration phase if the following milestones not met (9/30/14):

- # of tech. tools developed >4
- Case study library developed >20 case studies
- # Case study templates >1
- # of program energy saving tracking tools developed > 1
- # of program guides & templates developed > 5



2030 Districts provide a common platform for each district's unique ways of defining goals and creating a common mode of discussion

2030 DISTRICTS

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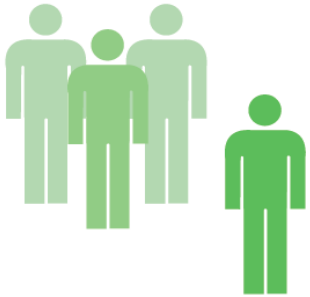
2030 Districts act as a concierge and GP – pointing partners towards tools for accurate diagnosis and treatment

2030 Districts

For Building Owners, Managers and Developers

Utilize special financing programs

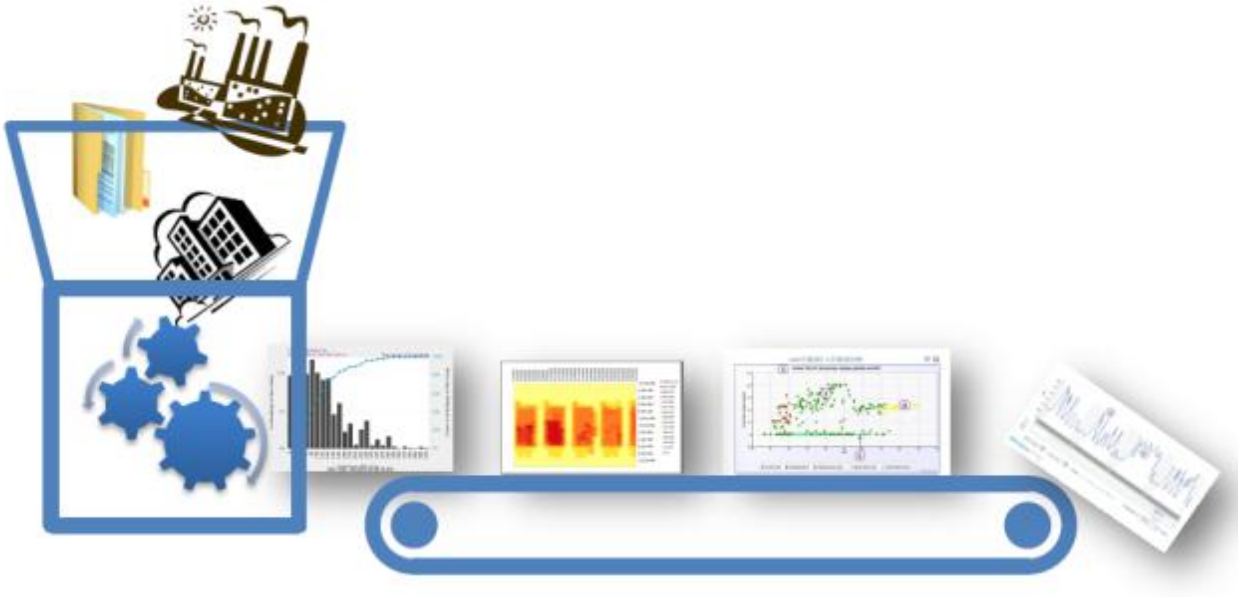


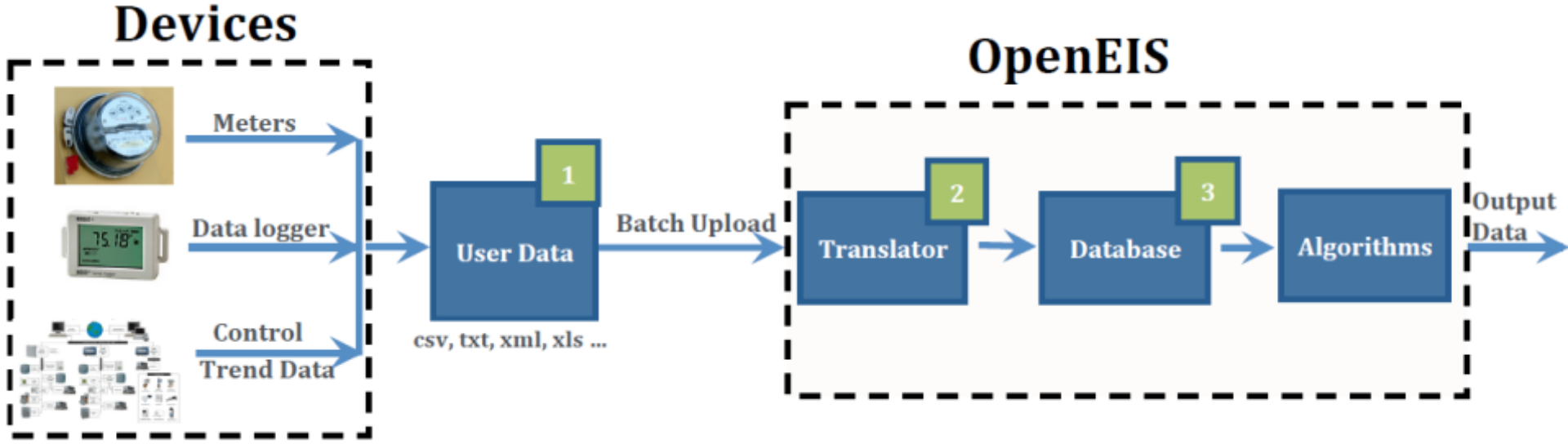
Improve competitive positioning

Access exclusive incentives, discounts & programs

Receive comparative analysis reports

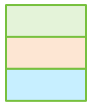
Small Commercial Toolkit: Web Resource Landscape



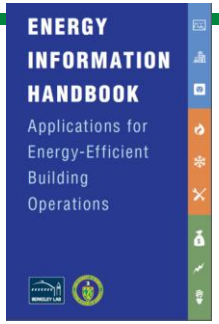

Devices
Meters
Data logger
Control
Trend Data
1
User Data
csv, txt, xml, xls ...
Batch Upload
OpenEIS
2
Translator
3
Database
Algorithms
Output
Data

Operations: Energy Information Handbook

How to design performance data systems
How to utilize performance data



Reporting and Tracking Methods
Fundamental Methods
Advanced Methods



www.eis.lbl.gov

Minimum Data Requirements

Analysis Methods	Utility		Interval Meter		Submeter			Other*
	Gas	Electric	WB Gas	WB Electric	Heating Load	Cooling Load	Lighting Load	
Simple Tracking	●	●						
Utility Cost Accounting	●	●						
Internal Rate of Return	●	●						●
Carbon Accounting	●	●						●
Longitudinal Benchmarking	●	●						●
Cross-Sectional Benchmarking	●	●						●
Loading Profiling			●	●				
Peak Load Analysis				●				
PV Monitoring								●
Loading Histograms					●	●		
Simple Baselines	●	●						●
Model Baselines			●	●				●
Lighting Efficiency							●	●
Heating and Cooling Efficiency					●	●		●
Energy Signature	●	●						●
Energy Savings	●	●						●
Cumulative Sum	●	●						●
Anomaly Detection			●	●				●

WB = whole-building.

*Other includes for example, weather data, square footage, or equipmment costs.

Applicable Building Systems

Analysis Methods	Whole Building	Heating	Cooling	Lighting	Plug Loads
Simple Tracking	●	●	●	●	●
Utility Cost Accounting	●	●	●	●	●
Internal Rate of Return	●	●	●	●	●
Carbon Accounting	●	●	●	●	●
Longitudinal Benchmarking	●	●	●	●	●
Cross-Sectional Benchmarking	●	●	●	●	●
Loading Profiling	●	●	●	●	●
Peak Load Analysis	●				
PV Monitoring*	●				
Loading Histograms		●	●		
Simple Baselines	●	●	●	●	●
Model Baselines	●	●	●	●	●
Lighting Efficiency				●	
Heating and Cooling Efficiency		●	●		
Energy Signature	●	●	●		
Energy Savings	●	●	●	●	●
Cumulative Sum	●	●	●	●	●
Anomaly Detection	●	●	●	●	●

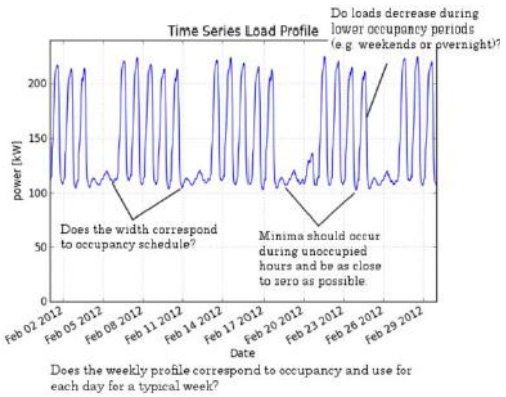
*Energy production from PV arrays is typically accounted for at the whole-building level.

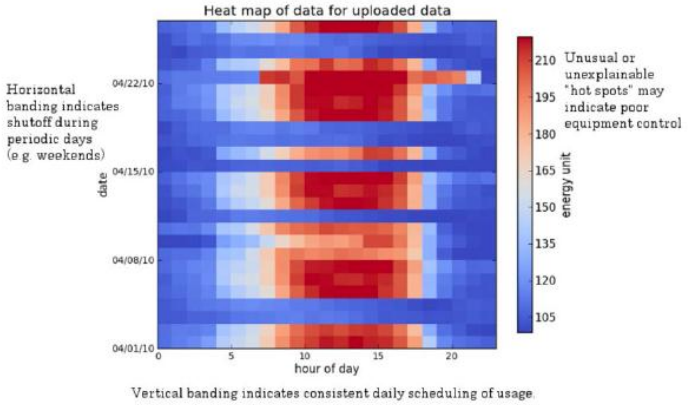
Interpretation of Method Output

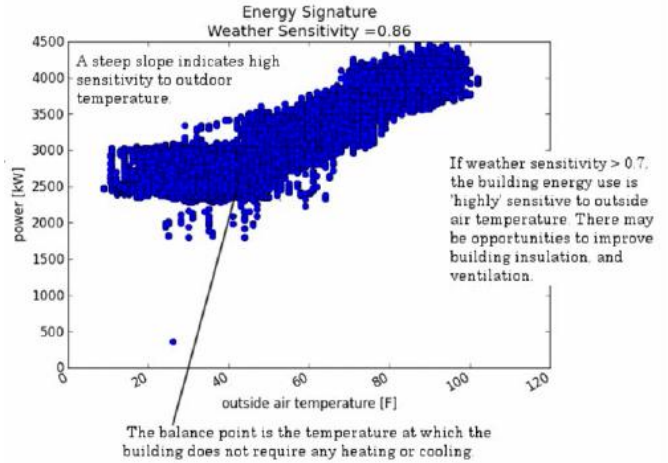
Analysis Methods	Requires Minimal Expertise ... Requires Advanced Expertise
Simple Tracking	
Utility Cost Accounting	
Internal Rate of Return	
Carbon Accounting	
Longitudinal Benchmarking	
Cross-Sectional Benchmarking	
Loading Profiling	
Peak Load Analysis	
PV Monitoring	
Loading Histograms	
Simple Baselines	
Model Baselines	
Lighting Efficiency	
Heating and Cooling Efficiency	
Energy Signature	
Energy Savings	
Cumulative Sum	
Anomaly Detection	

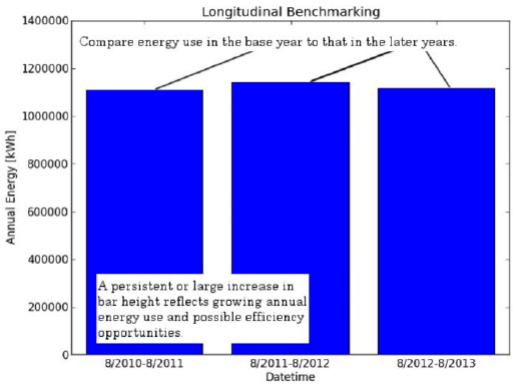
Operations: Open EIS

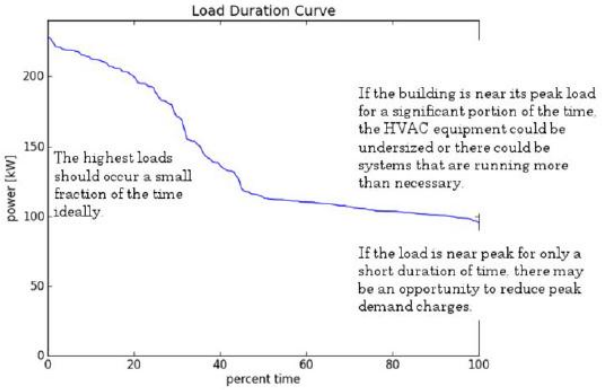
Using Visualization to Inform Next Steps











Algorithms

Time Series Load Profiling

Heat Maps
Energy Signature
Weather Sensitivity
Longitudinal Benchmarking
Base-to-Peak Load Ratios
Load Duration Curve
Load Variability

Operations: Open EIS

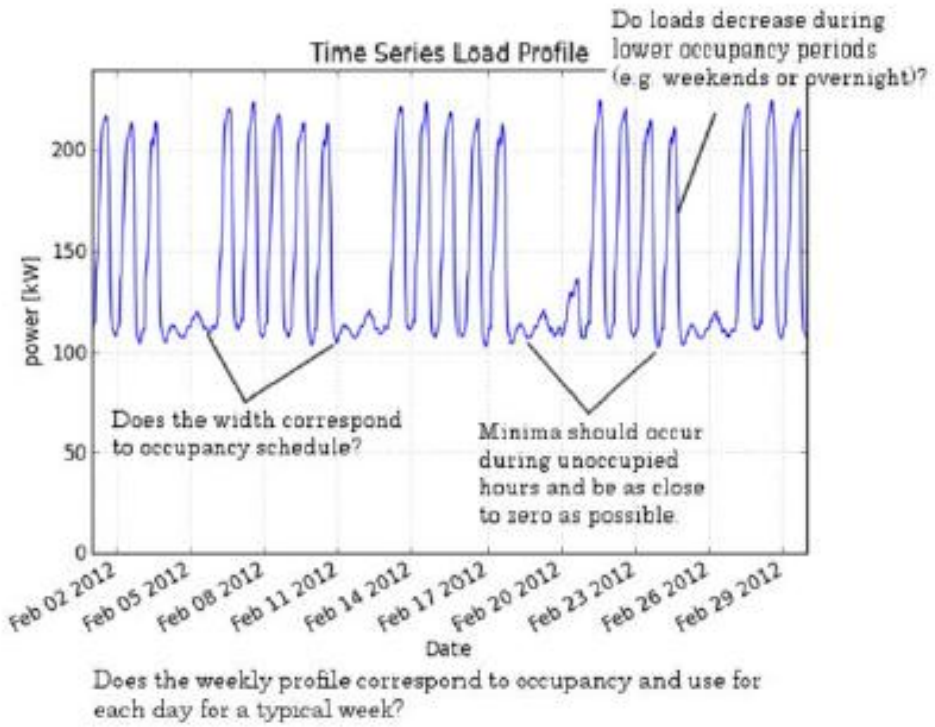


Figure 1. OpenEIS reference code output for time series load profiling

Algorithms

Time Series Load Profiling

Heat Maps
Energy Signature
Weather Sensitivity
Longitudinal Benchmarking
Base-to-Peak Load Ratios
Load Duration Curve
Load Variability

- Abnormalties or changes in load profiles = potential efficiency opportunities

Operations: Open EIS

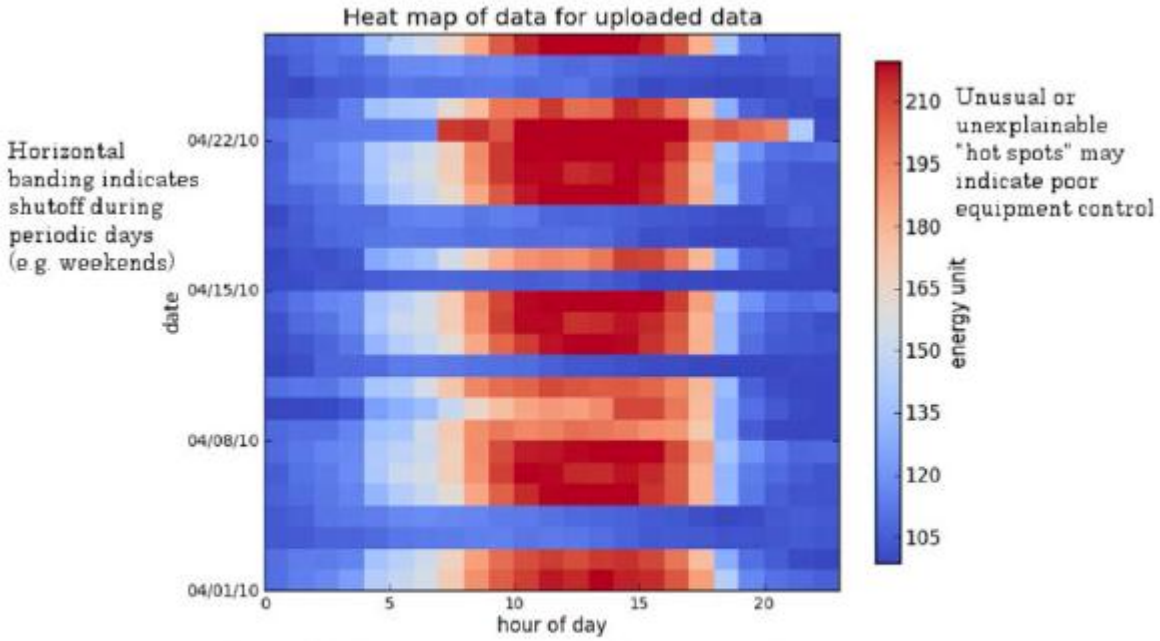


Figure 2. OpenEIS reference code output for heat maps

Algorithms

Time Series Load Profiling

Heat Maps

Energy Signature

Weather Sensitivity

Longitudinal Benchmarking

Base-to-Peak Load Ratios

Load Duration Curve

Load Variability

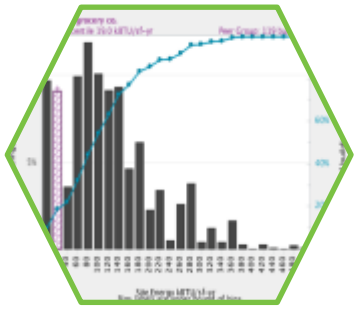
- The color code and mapping allow identification of hot spots to investigate further.

Energy Management Package - Auditing

- Streamlined package for energy management: guidelines & worksheets
- Focused on operational savings measures
- Delivered by HVAC contractors

Element 1: Monthly Data & Benchmarking

Analyze monthly data & benchmark



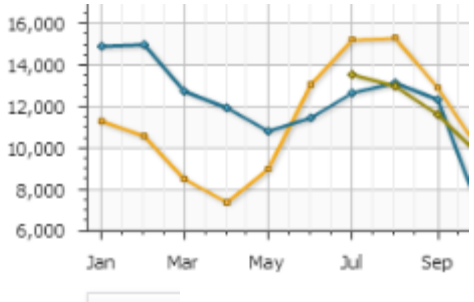
Requires:

- At least 1 year of monthly electricity and fuel use;
- Building floor area & type;
- 30-60 minutes

A) What are the seasonal patterns?

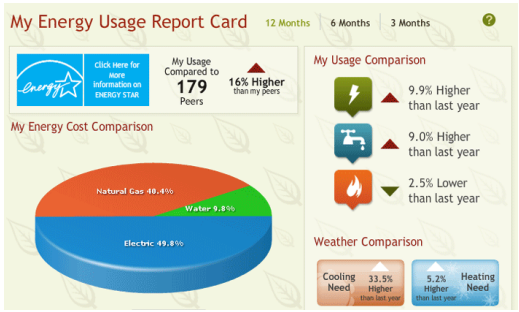
from Noesis

B) How does this year compare with the previous year?



C) How does my building compare to others?

- Energy use intensity (kBTU / sf – yr)
- % of buildings with higher EUI (Energy Star Score)



from GreenQuest

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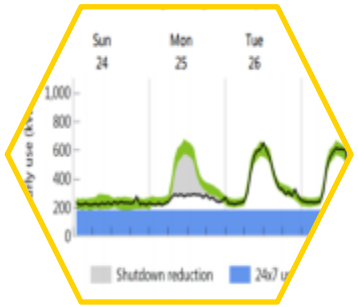
Element 2: Interval Data

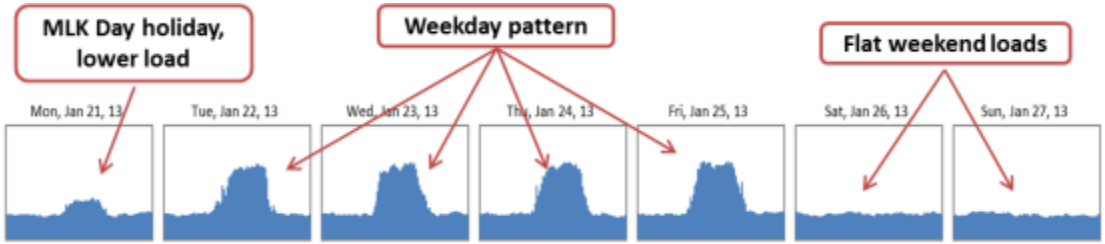
Analyze interval data



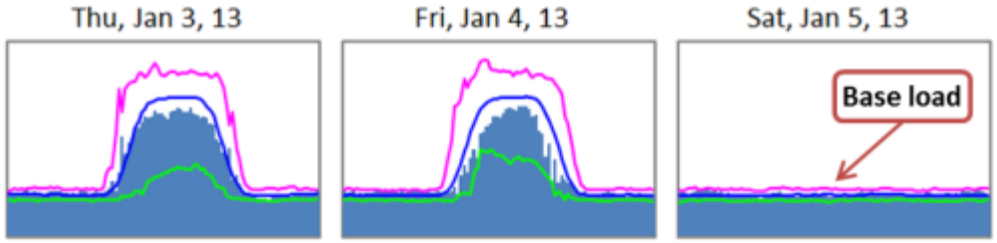
Requires:

- 3-12 months of hourly (smart meter) electricity data
- 30-60 minutes

A) Are the daily and weekly load schedules as expected?



B) How much energy is used at night and on weekends (Base load)?



from BizEE

C) Are there spikes or unusual activity ?

D) Can peak loads be reduced or shifted to non-peak periods in the day?

E) Are there changes over time?

Element 3: Walkthrough

Walkthrough

1 hour walkthrough at building site

Check lighting & thermostat settings

Consult with manager about energy management practices

E3 Walkthrough Worksheet

Building:_____ Date:_____
Facility contact name: _____
Phone: _____

Building operating hours:
Weekdays _____ to _____
Saturday: _____ to _____
Sunday: _____ to _____

STEP 1 Overview

List major energy consuming equipment in this building:_____

✔	If issues were highlighted in:	Pay special attention to question number:
	E2 Step 3: High evening / weekend / base load	1, 5, 6, 7, 8, 11c, 11e, 12 (office), 13 (kitchen)
	E2 Step 2: Load schedule does not match occupancy schedule	8, 11a, 13 (kitchen)
	E2 Step 5: High peak, daytime loads	11b, 11d, 9
	E1 Step 5: High seasonal variability	10

Questions in **bold** below are the typically the most important to assess.

STEP 2 Look for these items throughout the building

#	Description	Yes	No	NA	Corrective Action / Comments	Solved ?
1	**Are occupancy sensors installed and working? Are they placed appropriately?** Consult manager / occupant about functioning.					
2	**Are incandescents or T12 fixtures present?**					
3	Are fans or portable space heaters being used?					
4	Are radiators and air vents clear and unobstructed?					

E3 Walkthrough Worksheet -- DRAFT: Do not Circulate

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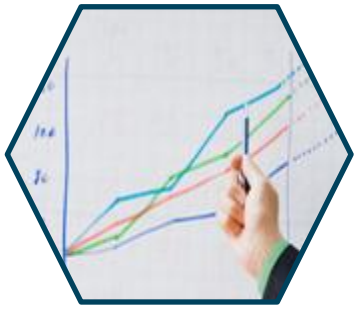
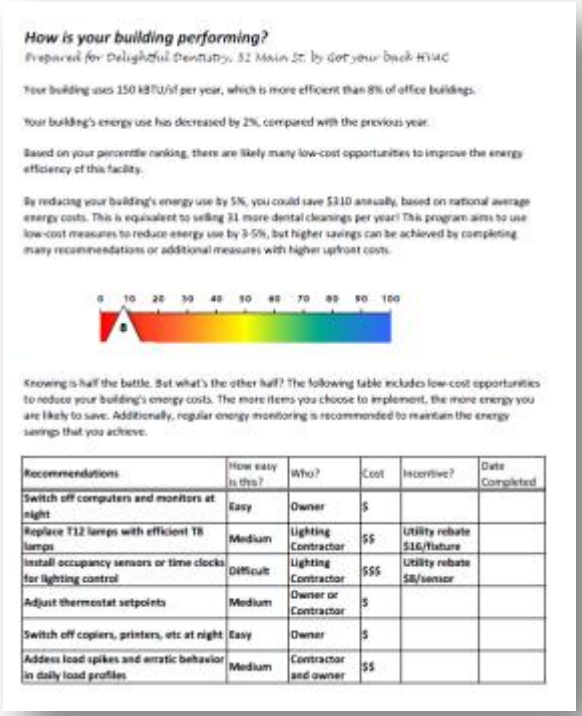
Element 4: Communicate with Owner

Communicate with owner



- Tips on pitching efficiency measures
- Tool to generate summary (right)
- Incentive identification
- Goal setting guidelines
  - *"I think together we can improve the Energy Star Score by 5 points this year."*



How is your building performing?

Prepared for Delightful Dentistry, 52 Main St. by Get your Duck HVAC

Your building uses 150 kBTU/sf per year, which is more efficient than 8% of office buildings.

Your building's energy use has decreased by 2%, compared with the previous year.

Based on your percentile ranking, there are likely many low-cost opportunities to improve the energy efficiency of this facility.

By reducing your building's energy use by 5%, you could save $310 annually, based on national average energy costs. This is equivalent to selling 31 more dental cleanings per year! This program aims to use low-cost measures to reduce energy use by 3-5%, but higher savings can be achieved by completing many recommendations or additional measures with higher upfront costs.

0 10 20 30 40 50 60 70 80 90 100

Knowing is half the battle. But what's the other half? The following table includes low-cost opportunities to reduce your building's energy costs. The more items you choose to implement, the more energy you are likely to save. Additionally, regular energy monitoring is recommended to maintain the energy savings that you achieve.

Recommendations	How easy is this?	Who?	Cost	Incentive?	Date Completed
Switch off computers and monitors at night	Easy	Owner	$		
Replace T12 lamps with efficient T8 lamps	Medium	Lighting Contractor	$$	Utility rebate $16/fixture	
Install occupancy sensors or time clocks for lighting control	Difficult	Lighting Contractor	$$$	Utility rebate $8/sensor	
Adjust thermostat setpoints	Medium	Owner or Contractor	$		
Switch off copiers, printers, etc at night	Easy	Owner	$		
Address load spikes and erratic behavior in daily load profiles	Medium	Contractor and owner	$$		

Element 5: Check Results

Check results

Requires:

- Updated monthly and/or hourly data
- 30-60 minutes

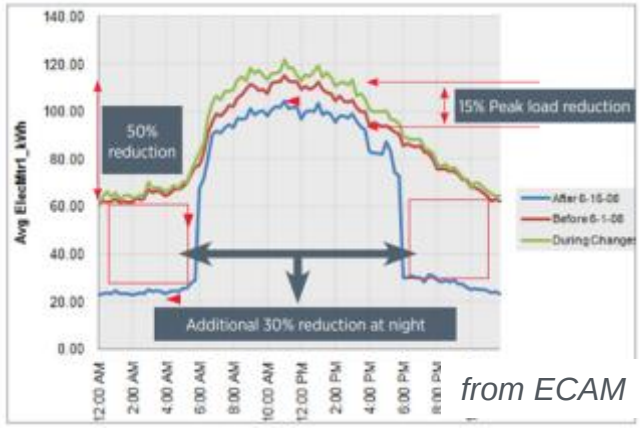
A) How much energy as been saved?

B) Can we verify changes to scheduling?

C) Further steps to energy efficiency

D) Leveraging success in future sales opportunities

from Noesis



from ECAM

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EMP is one option for 2030 Districts

BERKELEY LAB
Lawrence Berkeley National Laboratory

1 *Introduce package*

2030 DISTRICT™

3 *Provide contractor training and tools*

2 *Owners request contractors to deliver package*

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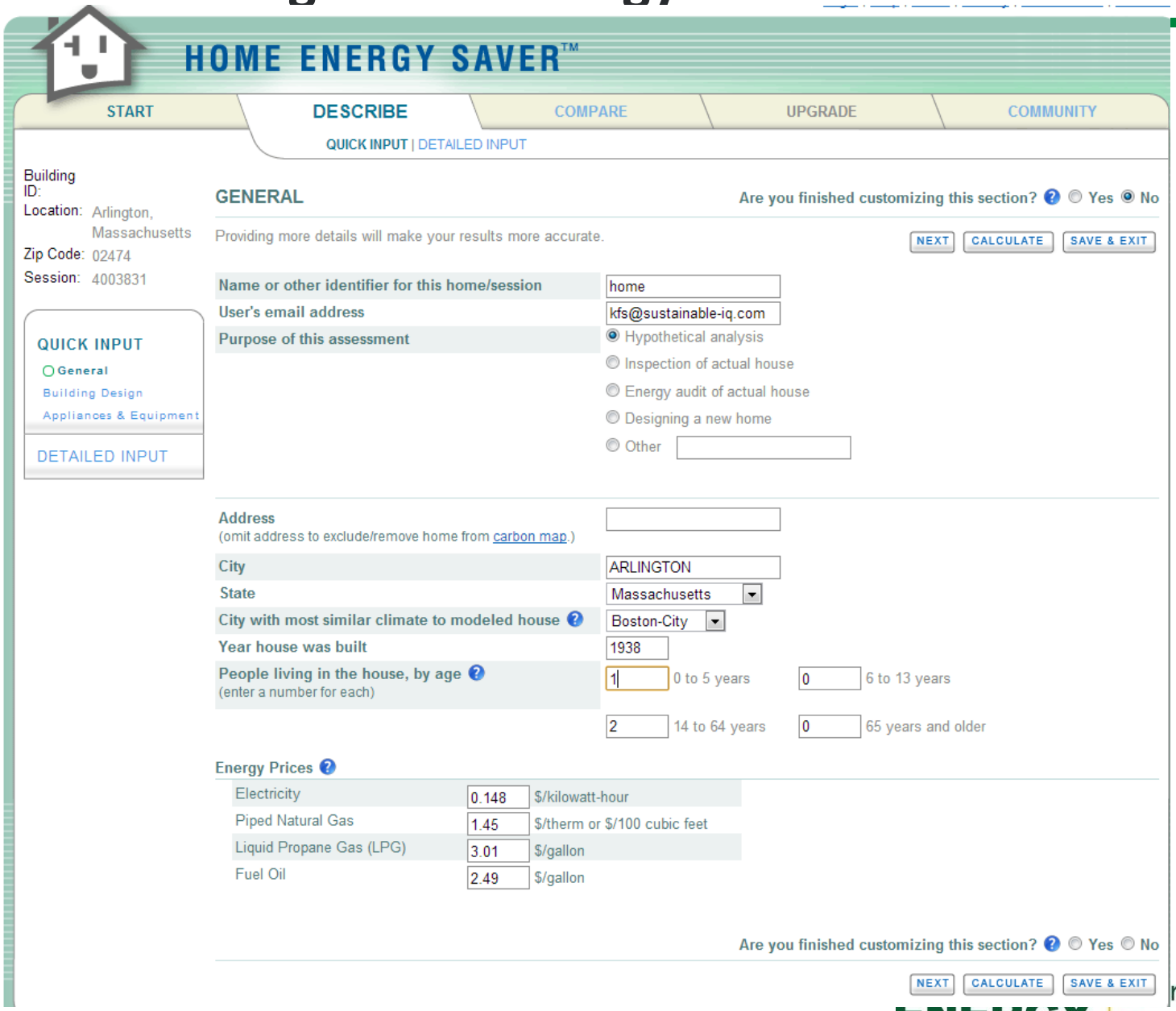
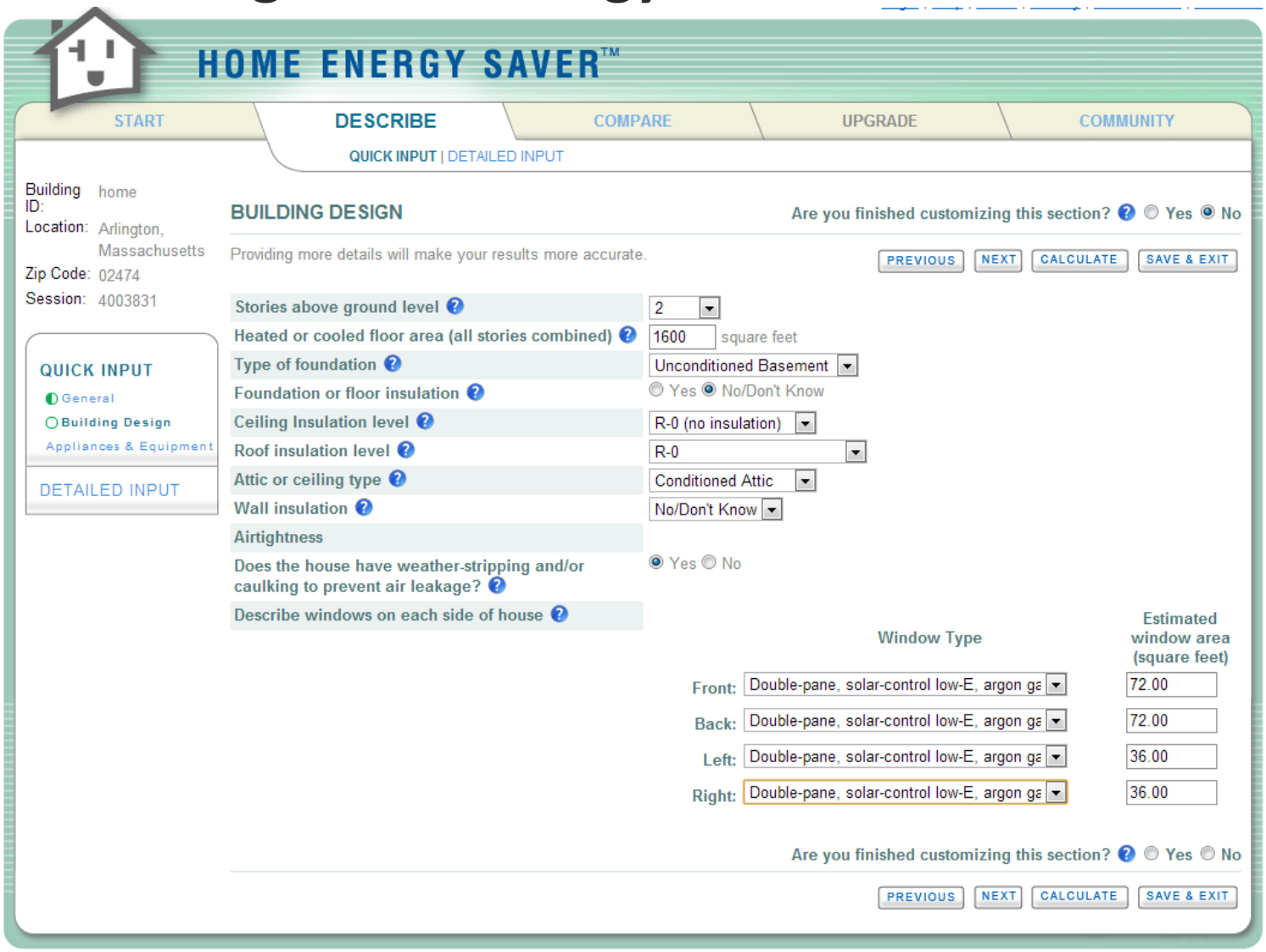
Whole Building: Small Commercial Retrofit Tool

Evaluates whole building approaches to save energy. Will be modeled after the Home Energy Saver online tool.

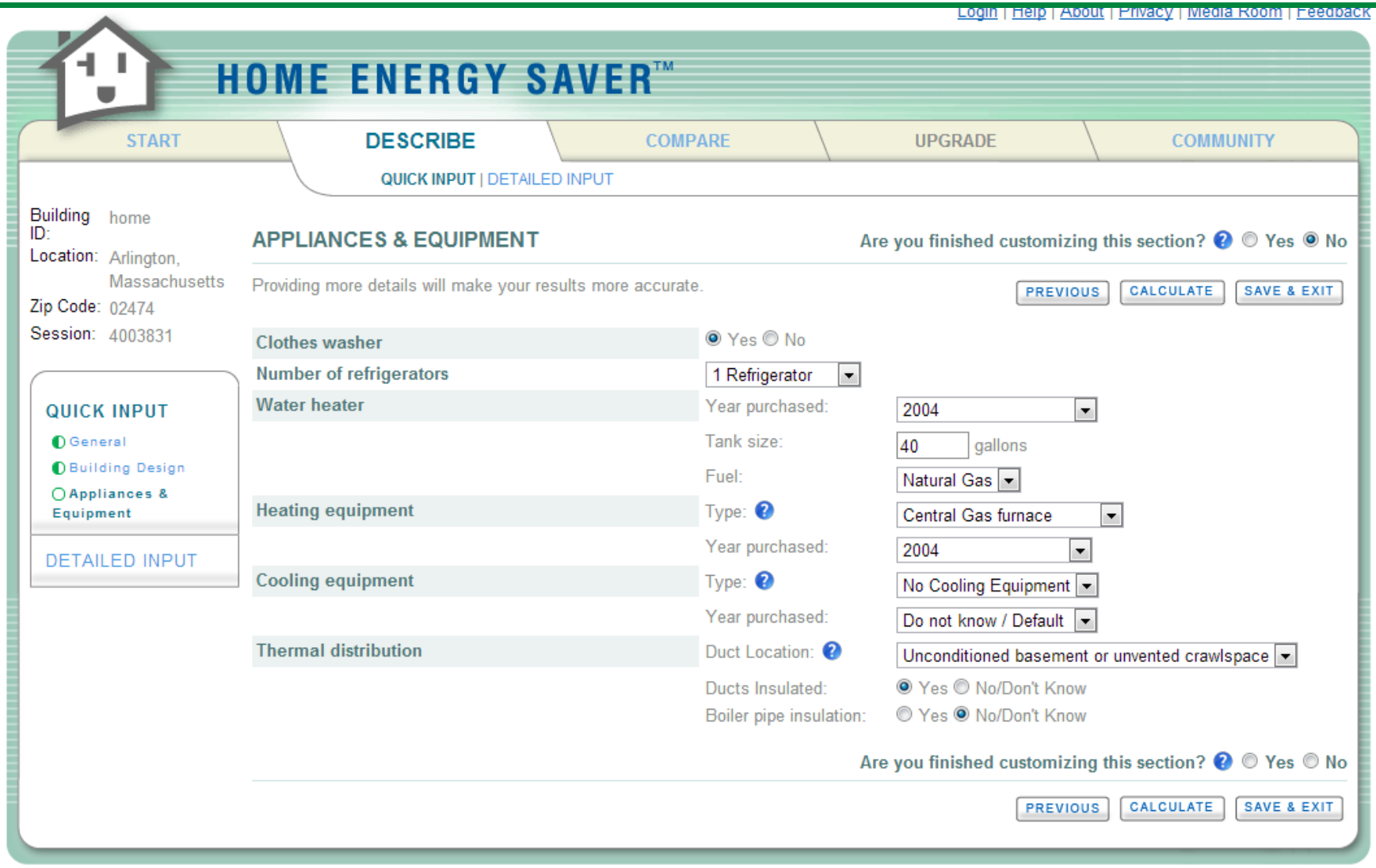
Whole Building: Home Energy Saver



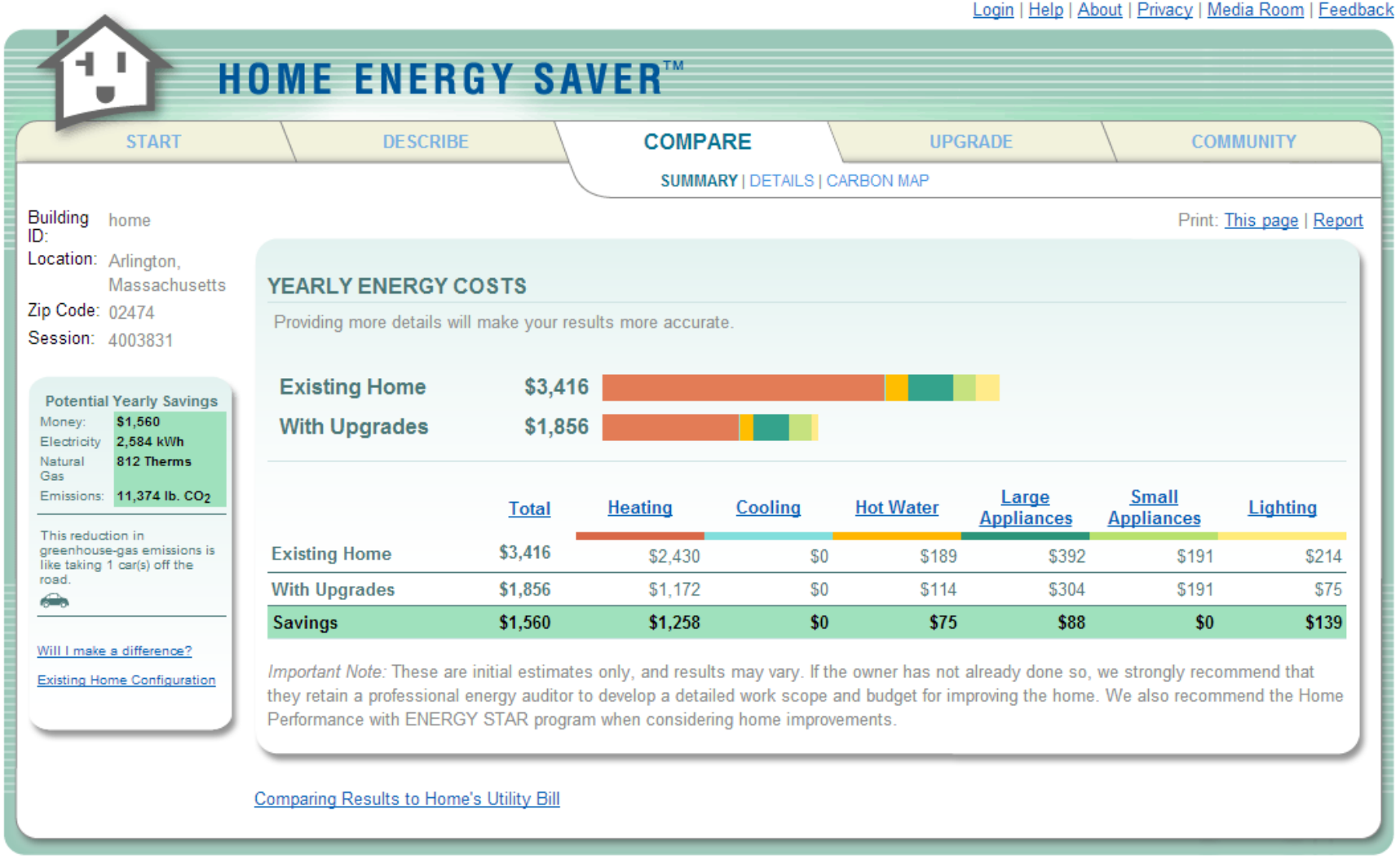
Whole Building: Home Energy Saver



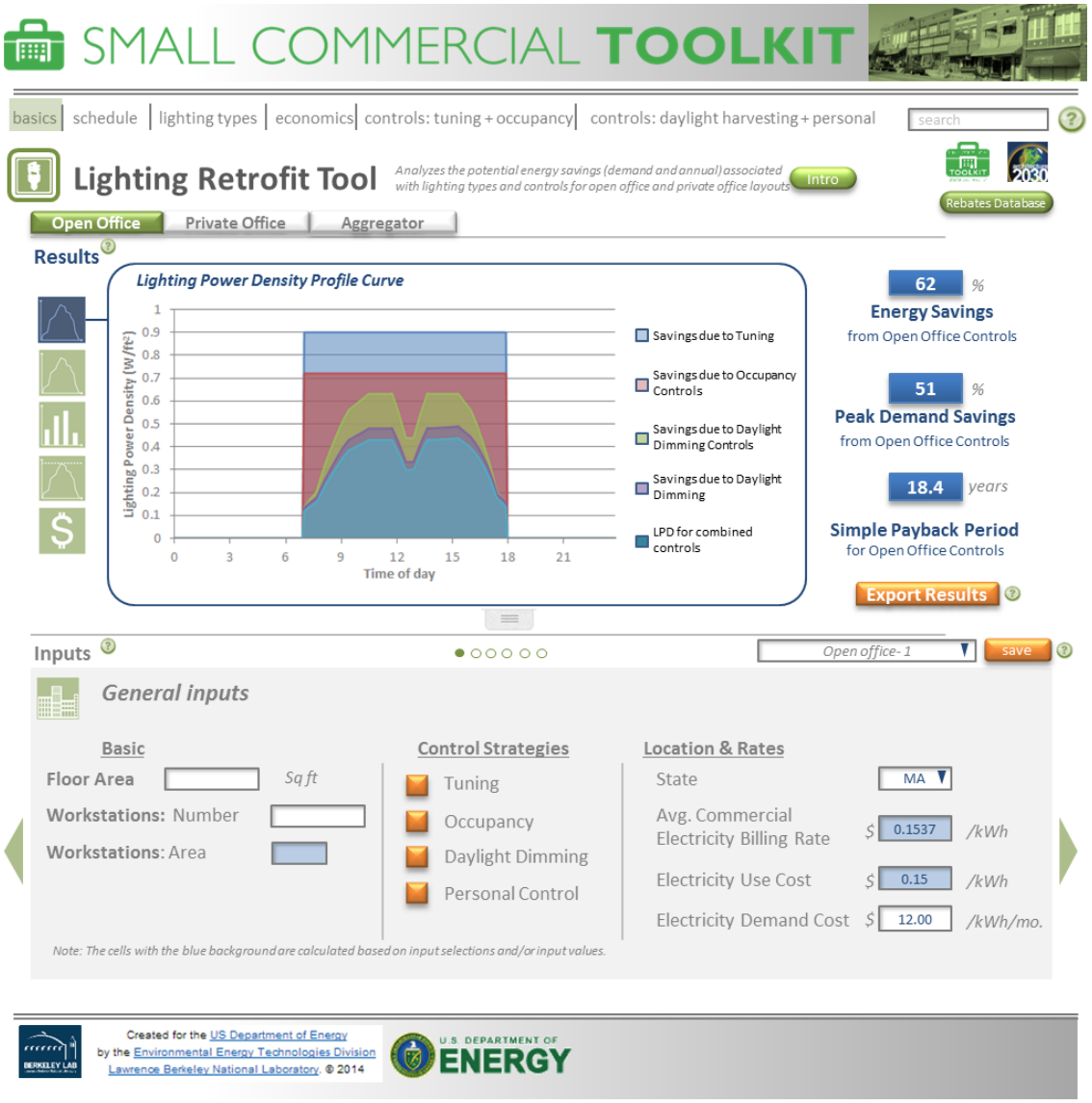
Whole Building: Home Energy Saver



Whole Building: Home Energy Saver



Lighting Retrofit Calculator (Inputs) - Mockup



Types: Open Office & Private Office

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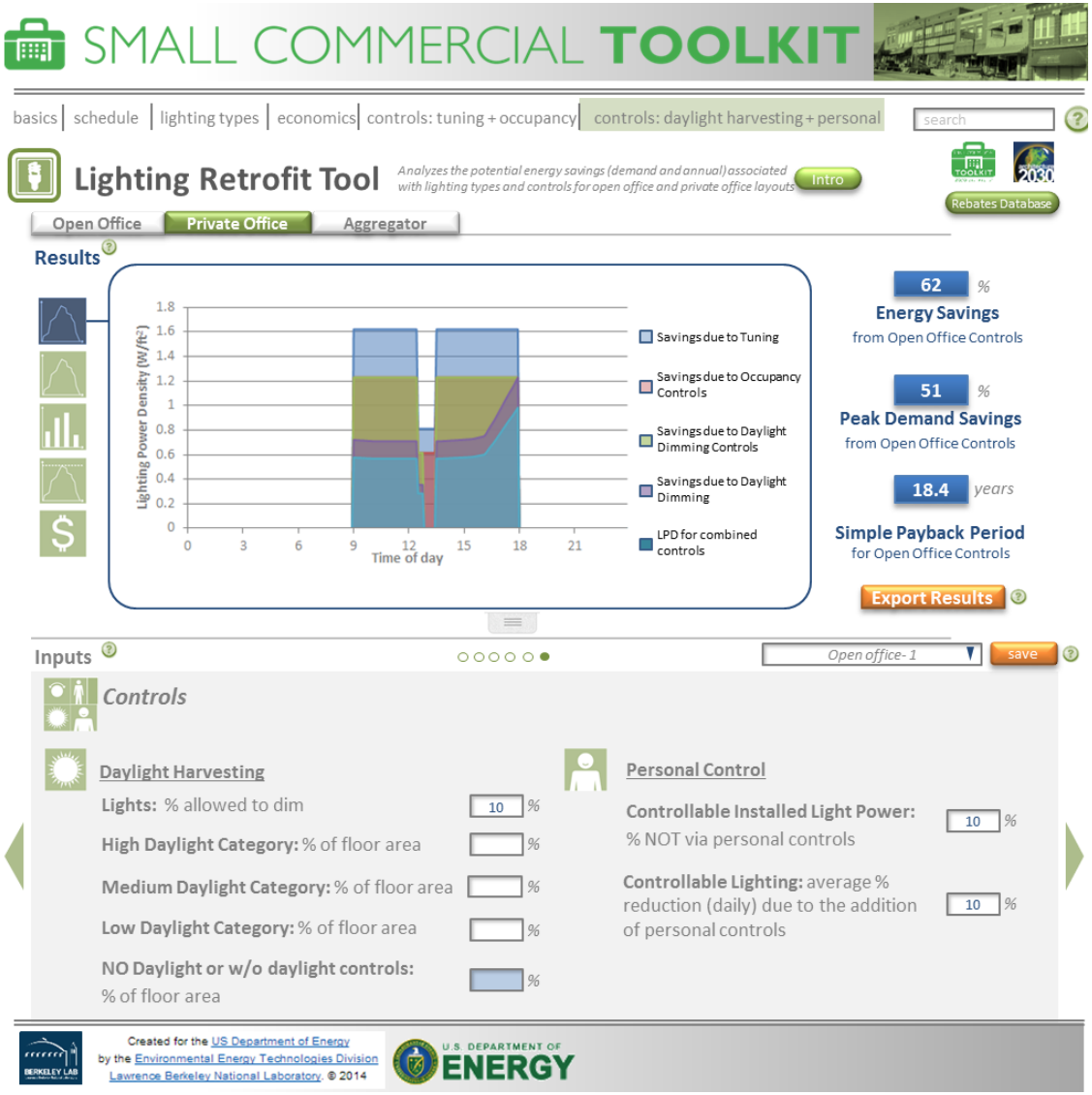
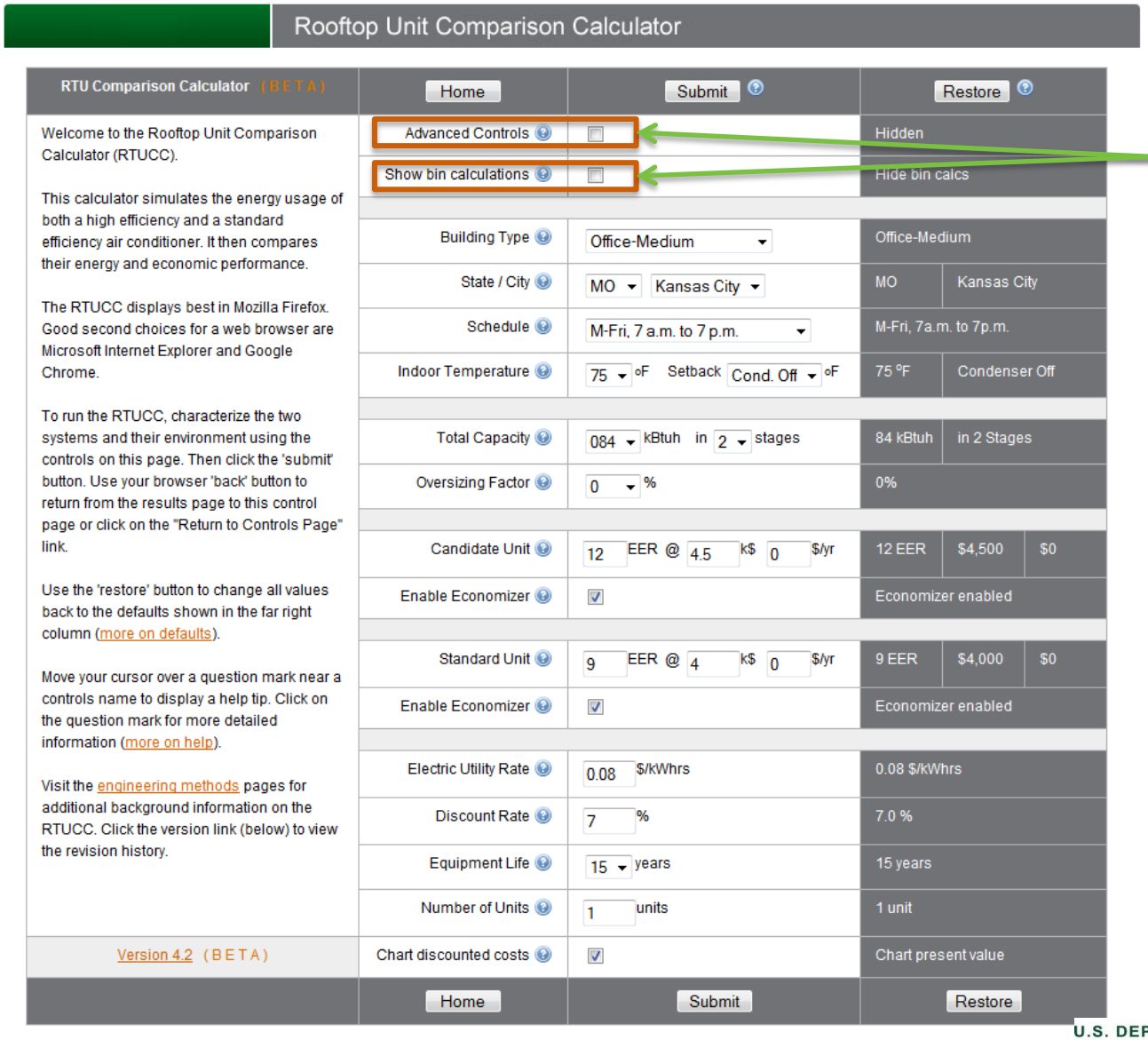
Lighting Retrofit Calculator (Inputs) - Mockup



Rooftop Unit Comparison Calculator (Inputs)



For more detailed analysis…

Source: http://www1.eere.energy.gov/femp/technologies/eep_eccalculators.html

Rooftop Unit Comparison Calculator (Results)

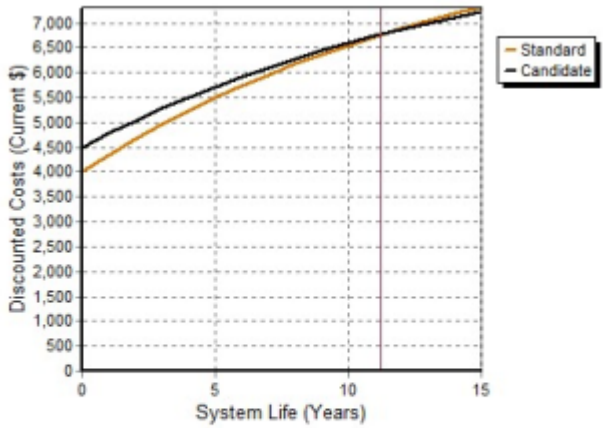
Rooftop Unit Comparison Calculator

Return to Controls Page

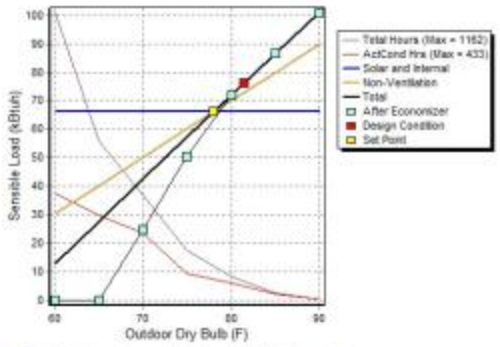
Return to RTUCC Home

RESULTS

SEATTLE, WA	Candidate	Standard	Savings
Annual Energy Consumption (kWhrs)	3,726	4,548	822
Annual Operating Cost ($)	298	364	66
15 Year Life Cycle Cost ($)	7,215	7,314	99
Annualized Cost ($)	792	803	11
Net Present Value ($)	99		
Payback (yrs)	11.2		
Rate of Return (%)	10.01		
Savings to Investment Ratio (SIR)	1.20		

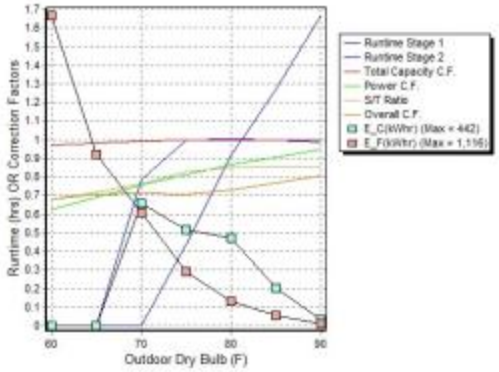


BIN CALCS: Loads and Hours — Candidate



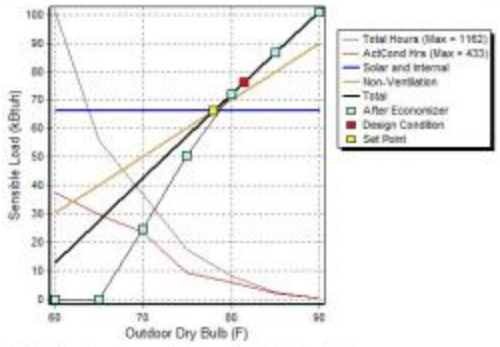
Note: The 'Hours' trace is normalized (see MAX value in legend)

BIN CALCS: Equipment Performance — Candidate Unit



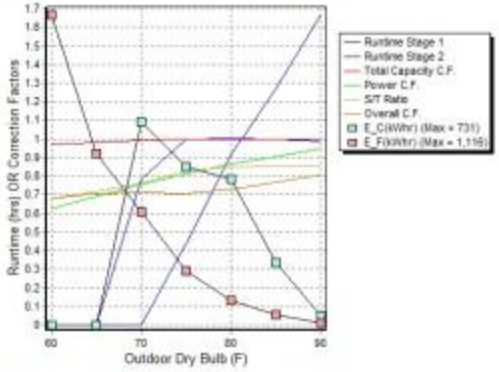
Note: The 'kWhrs' traces are normalized (see MAX values in legend)

BIN CALCS: Loads and Hours — Standard Unit



Note: The 'Hours' trace is normalized (see MAX value in legend)

BIN CALCS: Equipment Performance — Standard Unit



Note: The 'kWhrs' traces are normalized (see MAX values in legend)